

PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

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Applicant's or agent's file reference P03013WO		FOR FURTHER ACTION See Form PCT/PEA/416	
International application No. PCT/DK2004/000168	International filing date (day/month/year) 15.03.2004	Priority date (day/month/year) 14.03.2003	
International Patent Classification (IPC) or national classification and IPC G08G1/0967, G01N21/17, G01W1/02			
Applicant LIWAS APS			
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 7 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau a total of 9 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>			
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input checked="" type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>			
Date of submission of the demand 14.01.2005		Date of completion of this report 30.11.2005	
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized Officer Seisdados, M Telephone No. +49 89 2399-7982 	

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/DK2004/000168

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

Description, Pages

1-21 received on 29.03.2004 with letter of 15.03.2004

Claims, Numbers

1-32 filed with telefax on 09.11.2005

Drawings, Sheets

1/5-5/5 received on 29.03.2004 with letter of 15.03.2004

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/DK2004/000168

Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application,

☒ claims Nos. 30-32

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (specify):

☐ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. are so unclear that no meaningful opinion could be formed (*specify*):

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

☒ no international search report has been established for the said claims Nos. 30-32

☐ the nucleotide and/or amino acid sequence listing does not comply with the standard provided for in Annex C of the Administrative Instructions in that:

the written form

☐ has not been furnished

☐ does not comply with the standard

the computer readable form

☐ has not been furnished

☐ does not comply with the standard

☐ the tables related to the nucleotide and/or amino acid sequence listing, if in computer readable form only, do not comply with the technical requirements provided for in Annex C-*bis* of the Administrative Instructions.

☐ See separate sheet for further details

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/DK2004/000168

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-7,9-19,21-29
	No: Claims	
Inventive step (IS)	Yes: Claims	1-7,9-19,21-29
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-29
	No: Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

The references to the first and second invention will be made according to the written opinion dated 12.08.05.

1. First invention (claims 24-29)

As indicated on the written opinion on 12.08.05 claims 24 and 28 appear to comply with the requirements of Art. 33(2)PCT.

However, dependent claim 27 does not fulfil the requirements of Art. 6 PCT because the dependency it claims, "any of claims 1-14", is not clear to the reader, since claims 1-14 define another invention and can therefore not be taken into account. The mentioned features should be defined explicitly.

2. Second invention (claims 1-23)

1. The subject-matter of **claim 1** relates to a sensor device for contactless detection of the conditions of a surface, in particular the presence of snow, water or ice, using a light source and two receptors, each receiving a portion of the said emitted light.

The closest prior art is represented by document D5, which describes a device designed to assess the brightness of a surface such as skin, including a light source, two receptors and the corresponding analysers for assessing the specular and diffuse brightness.

Hence, claim 1 and the device defined in D5 refer to two different technical fields and the Examiner does not see why the person skilled in the art would have the motivation to transfer the knowledge from D5 to the field of snow, water or ice detection. Moreover, the technical implications in each case are of different nature, since the detection of human skin brightness is based on the surface irregularities

(see col.5, lines 3-11 in D5), whereas claim 1 is aimed at detecting the angle of reflection of light which is representative of either snow, water or ice.

The technical problem to be solved by the present invention, therefore, is to provide a sensor device for detecting the presence of snow, ice or water.

Another interesting document is D6, which describes a sensor device for measuring the quantity of salt on a road surface for snow situations. However, due to the different nature of the element under test the technical relevance from the mentioned sensor device differs to that of claim 1.

Claims 2-14 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

Use **claim 15** also claims the technical features defined above. The same arguments can therefore be applied to claims 15, which appear therefore to be new (Art.33(2) PCT).

2. **Independent claim 19** claims a sensor device for contactless detection of the conditions of a surface comprising a light emitter and two detectors, and at least a further light source or a noise sensor. The combination of these elements is not known from the prior art, since in the prior art documents the configuration used is emitter-2detectors but no further light sources or noise detectors.

Claim 19 appears therefore to fulfil the requirements of Art. 33(2) PCT.

3. **Dependent claim 23** does not meet the requirements of Art. 6 PCT, since the multiple dependency it claims is not clear. For example, claim 23 can not be dependent on claims 2 and 22 simultaneously, since they both define the direction of the emitted light but they claim different angles. Claim 23 should therefore clearly define which features are relevant to its subject-matter.

4. The Examiner is still of the opinion that **claims 8 and 20** do not fulfil the requirements of Art.19(2). As the Applicant describes on the letter dated 09.11.05, the description defines two ranges of high absorbance by water, 930-970 nm and 1450nm but explicitly indicates that 1450nm is not desirable due to the higher costs. Hence, it is to be understood that although there are two ranges of high absorbance by water only one (930-970 nm) is disclosed, rendering claims 8 and 20 not allowable since their subject-matter is broader than originally filed.

Finally, the Examiner wishes to point out that features following expressions "such as" or "preferably" have no limiting effect on the scope of the claims, thus rendering the matter of which protection is sought unclear (Art.6 PCT).

3. Further inventions (claims 30-32)

Since no examination fees have been paid for inventions 3 and 4 (see Invitation to restrict or pay additional fees on 08.07.05) no substantive examination will be carried out for claims 30-32.

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INTERNATIONAL APPLICATION NO. PCT/DK2004/000168
AMENDED CLAIMS FILED 9 NOVEMBER 2005

- 5 1. Sensor device for non-contact detection of conditions of a surface, such as a road surface, the sensor device comprising
- a light source for emitting light towards the surface,
- a first detector arranged for receiving a portion of said emitted light when reflected from said surface and producing a first output according to the intensity
- 10 thereof,
- a second detector arranged for receiving a portion of said emitted light when reflected from said surface and producing a second output according to the intensity thereof, and
- control means for receiving and evaluating the received output from the
- 15 detectors based on the amount of diffuse reflected and mirror reflected light, characterised in that
- the sensor device include data processing means for detecting the presence of snow, ice or water from the output of said first and second detector, and in that the sensor device further comprises
- 20 a first linear polarization filter arranged in the path of the light from the light source and to the surface for the polarization of the emitted light, and
- a second linear polarization filter arranged in the path of the light between said surface and one of the first detector and the second detector.
- 25 2. Sensor device according to claim 1, wherein the light source is arranged to emit light in a direction within 10° , preferably within 6° from the surface normal.
3. Sensor device according to claim 1 or 2, wherein the direction of polarization of the second filter is parallel to the direction of polarization of the first filter.
- 30

4. Sensor device according to claim 3, comprising a third polarization filter arranged in the path of the light between said surface and the other one of the first detector and the second detector, wherein the direction of polarization of the third filter is perpendicular to the direction of polarization of the first and the second filter.

5

5. Sensor device according to claim 3 or 4, wherein the first and second filter are constituted by one linear polarization filter and a beam splitter is arranged between the first polarization filter and the light source for the diversion of a portion of the light reflected from the surface into said detector.

10

6. Sensor device according to claim 1, 2 or 4, further comprising a first beam splitter arranged in the path of the light from the first linear polarization filter and to the surface for the diversion of a portion of the light reflected from the surface into a second path, and a second beam splitter arranged in the second path for the diversion of a portion of the light in the second path into the first detector and the transmission of a portion of the light in the second path into the second detector.

15

7. Sensor device according to any claims 1-6, comprising a reference light source arranged to emit light substantially in the direction and path of the first light source, wherein the reference light source emits light of a wavelength on which said polarization filters of the device have substantially no effect, so that the detection of the light from the reference light source by the first and second detector may be used for verification of the function of the system.

20

8. Sensor device according to any of claims 1-7, comprising a further light source for emitting light within an infrared wavelength range of high absorbance by water towards the surface and an absorption detector for receiving the reflection of said emitted light and producing an output to the control means accordingly.

25

9. Sensor device according to claim 8, wherein said further light source emits light within the wavelength range of 930 nm to 970 nm.

10. Sensor device according to any of claims 1-9, further comprising a light source
5 for emitting light towards the surface, the path of the light having an angle in the range of 15° to 70°, preferably in the range of 25° to 60° to the surface normal and a retro-reflection detector arranged for receiving the retro-reflection of said emitted light in said path and producing an output to the control means accordingly.

10 11. Sensor device according to any of claims 1-10, further comprising a light source for emitting polychromatic light towards the surface and at least two range detectors arranged to detect each a wavelength range of the reflection of said emitted light and producing an output to the control means accordingly.

15 12. Sensor device according to claim 11, comprising least three of said range detectors arranged to detect each a wavelength range of the reflection of said emitted light and producing an output to the control means accordingly.

20 13. Sensor device according to claim 11 or 12, wherein the said wavelength ranges each comprises a range within the visible wavelength range.

14. Sensor device according to any of claims 1-13 for mounting in a vehicle, further comprising a noise sensor for receiving the noise from the vehicle travelling along a road and producing an output to the control means accordingly.

25

15. Use of a sensor device for non-contact detection of the presence of water, snow and ice on a surface, the sensor device comprising
a light source for emitting light towards the surface,

a first detector arranged for receiving a portion of said emitted light when reflected from said surface and producing a first output according to the intensity thereof,

5 a second detector arranged for receiving a portion of said emitted light when reflected from said surface and producing a second output according to the intensity thereof, and

control means for receiving and evaluating the received output from the detectors based on the amount of diffuse reflected and mirror reflected light, characterised in that

10 the sensor device further comprises

a first linear polarization filter arranged in the path of the light from the light source and to the surface for the polarization of the emitted light, and

a second linear polarization filter arranged in the path of the light between said surface and one of the first detector and the second detector.

15

16. Use according to claim 15, wherein the sensor device is mounted in a vehicle.

17. Use according to claim 15 or 16 of a sensor device, wherein the light source is arranged to emit light in a direction within 20° from the surface normal.

20

18. Use according to any of claims 15 to 17, wherein the sensor device further has the technical features of any of claims 2-14.

19. Sensor device for non-contact detection of conditions of a surface, such as a road surface, the system comprising

25

a light source for emitting light towards the surface,

a first detector arranged for receiving a portion of said emitted when reflected from said surface and producing a first output according to the intensity thereof,

a second detector arranged for receiving a portion of said emitted when reflected from said surface and producing a second output according to the intensity thereof, and

5 control means for receiving and evaluating the received output from the detectors based on the amount of diffuse reflected and mirror reflected light, characterised in that

the device further comprises one or more arrangements for detecting conditions of the surface selected from a group comprising:

10 an infrared light source for emitting light within the wavelength range of 930 nm to 970 nm towards the surface and an absorption detector for receiving the reflection of said emitted infrared light and producing an output to the control means accordingly,

15 a light source for emitting light towards the surface, the path of the light having an angle in the range of 15° to 70°, preferably in the range of 25° to 60° to the surface normal and a retro-reflection detector arranged for receiving the retro-reflection of said emitted light in said path and producing an output to the control means accordingly,

20 a light source for emitting polychromatic light towards the surface and at least two range detectors, preferably at least three range detectors, arranged to detect each a wavelength range of the reflection of said emitted light and producing an output to the control means accordingly, and

a noise sensor for receiving the noise from a vehicle travelling along a road and producing an output to the control means accordingly, on which vehicle the device is arranged.

25

20. Sensor device for non-contact detection of conditions of a road surface, the sensor device comprising

a light source for emitting light towards the surface,

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a first detector arranged for receiving a portion of said emitted light when reflected from said surface and producing a first output according to the intensity thereof,

5 a second detector arranged for receiving a portion of said emitted light when reflected from said surface and producing a second output according to the intensity thereof, and

control means for receiving and evaluating the received output from the detectors based on the amount of diffuse reflected and mirror reflected light, characterised in that

10 the sensor device further comprises

a first linear polarization filter arranged in the path of the light from the light source and to the surface for the polarization of the emitted light,

a second linear polarization filter arranged in the path of the light between said surface and one of the first detector and the second detector, and

15 a further light source for emitting light within an infrared wavelength range of high absorbance by water towards the surface and an absorption detector for receiving the reflection of said emitted light and producing an output to the control means accordingly.

20 21. Sensor device according to claim 20, wherein said further light source emits light within the wavelength range of 930 nm to 970 nm.

22. Sensor device according to claim 20 or 21, wherein the light source is arranged to emit light in a direction within 20° from the surface normal.

25

23. Sensor device according to any of claims 20-22, which further has the technical features of any of claims 2-7 and 10-14.

24. A road surface property detection device for mounting in a vehicle, comprising

a sensor device having a radiation emitter directed towards the road surface and at least one detector for detecting the radiation reflected from the road surface and providing an output accordingly, and data processing means for processing the output from the at least one detector to determine surface properties of the road and
5 providing an output accordingly,

transmission means for receiving said output from the sensor device and conducting a wireless transmission of road surface property data based thereon to a receiver exterior to the vehicle,

characterised in that

10 the device further comprises wireless receiver means adapted to receive radio transmissions of data from transmission means of devices similar to the device itself, and

data output means for receiving an input from the receiver means and presenting an output perceivable by the driver of the vehicle based thereon.

15

25. A device according to claim 24, comprising

position means for generating position data for estimation of the current position of the device,

wherein the transmission means is arranged to transmit said position data.

20

26. A device according to claim 24 or 25, wherein the data output means further is arranged for receiving an input from the sensor device and presenting an output perceivable by the driver of the vehicle based thereon.

25 27. A road surface property detection device according to any of claims 24-26, wherein the sensor device comprises the characteristics of the device according to any of claims 1-14.

28. A system comprising

a plurality of devices according to any of claims 24-26 and 27 each mounted in a separate vehicle, and

a plurality of stationary detector means for contact-less detection of the surface properties of the road surface and providing an output accordingly to transmission means for receiving said output and conducting a wireless transmission of road surface property data based thereon to the receivers of said devices.

29. A system according to claim 28, comprising a plurality of stationary information arrangements having receiver means adapted to receive radio transmission data from the devices mounted in the vehicles as well as the stationary detector means, and comprising visual communication devices arranged along roads for distributing information to the drivers of vehicles on said roads based on said received road surface property data.

30. A road surface property detection device to be mounted on a vehicle for contact-less detection of the surface properties of the road surface and providing an output accordingly, comprising a radiation emitter directed towards the road surface and at least one detector for detecting the radiation reflected from the road surface and providing an output accordingly,

characterised in that

the device comprises washing means for the emitter and the at least one detector for recurrently flushing thereof.

31. A device according to claim 30, wherein said washing means is connected to and operates concurrently with a windshield washer system of the vehicle.

32. A road surface property detection device to be mounted on a vehicle for contact-less detection of the surface properties of the road surface and providing an output accordingly, comprising a radiation emitter directed towards the road surface and at

least one detector for detecting the radiation reflected from the road surface and providing an output accordingly,

characterised in that

- 5 at least one detector of the device comprises a shutter device for allowing a temporal access of radiation to the detector for a period of $1/10$ to $1/50,000$ seconds, preferably of $1/50$ to $1/10,000$ seconds.